TROLLEY SYSTEM FOR A RAILWAY BOXCAR DOOR

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 60/457,416 filed March 25, 2003 and U.S. Provisional Application No. 60/494,534 filed August 12, 2003, which are hereby incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The subject invention relates to railroad cars and, more particularly, to a trolley system for positioning the door of a railway car.

Description of Related Art

[0003] Railway boxcars typically include sliding doors which are doors which roll along a track to cover and uncover a similarly-shaped opening within the boxcar. Plug-type doors are similar to sliding doors because they roll along a track on the boxcar to cover or uncover an opening within the railway boxcar. However, plug-type doors additionally move axially in and out relative to the wall of the boxcar to not only cover the opening, but, furthermore, to seal the opening. The plug-type door attaches to a frame and rolls on upper and lower tracks. A crank mechanism is used to displace the door axially toward and away from the boxcar wall to seal and unseal the door opening. Plug-type doors, hereinafter referred to as "plug doors", were designed over fifty (50) years ago and, over the years, the American Association of Railroads ("AAR") developed standards and rules for plug door designs so that the industry had one uniform plug door design on the market. This eliminated the necessity of carrying many different parts to support the plug door designs of different manufacturers.

[0004] Today, the plug door design is essentially the same as it was fifty (50) years ago. Unfortunately, this design does not meet the current needs of industry. For example, occasionally the plug door becomes stuck and a forklift truck must be used to overcome this resistance and position the plug door. However, the force imparted by the fork lift tends to bend and damage the door. Additionally, racks which are transported in and out of the boxcar tend to hit and damage the door. Furthermore, the door becomes stressed from continual opening and closing. As a result, over time the door and the door support mechanism become stressed and the mechanism becomes more difficult to operate. Additionally, the plug door is operated by a crank mechanism and when the door support mechanism becomes difficult to operate, the crank mechanism may also be difficult to

operate. In some instances, fork trucks and racks may hit the inside of the door causing pins within the door support mechanism to shear which, in turn, may cause the door to fall from the boxcar.

[0005] Attempts have been made to address these present problems by applying stickers to the plug doors warning that opening the door improperly may cause it to fall. It is currently recommended that plug doors be inspected prior to opening to ensure that the door is properly supported and may be opened safely.

[0006] While this problem has been described in relation to plug doors on railway boxcars, it should be appreciated that similar problems exist with simple sliding doors on railway boxcars. Therefore, it is an object of the subject invention to overcome these deficiencies in the prior art.

SUMMARY OF THE INVENTION

[0007] The subject invention is a trolley system for positioning the door of a railway boxcar in response to the rail and boxcar industry demand for safety. The subject invention is also a mechanical device for opening and closing the doors associated with these railway cars.

[0008] In one embodiment of the subject invention, a trolley system for positioning the door of a railway boxcar to cover or uncover an opening in a wall of the railway boxcar opening has an upper track mounted upon the railway boxcar and an upper trolley having a body with at least one roller rotatably secured therein, wherein the at least one roller of the upper trolley co-acts with the track. A safety plate is connected to the railway boxcar and positioned above and adjacent to the at least one roller of the upper trolley, wherein the plate physically limits the vertical movement of the roller in the upper trolley to prevent derailment of the upper trolley from the upper track.

[0009] In another embodiment of the subject invention, a railway boxcar has a base with railway boxcar rollers secured to the base and an enclosure attached to the base, wherein the enclosure has a door opening. An upper track is defined at an upper portion of the enclosure adjacent the door opening. The upper track has a U-shaped cross section. A lower track is defined at a lower portion of the enclosure adjacent the door opening and has a U-shaped cross section. An upper cage surrounds the upper track and a lower cage surrounds the lower track. An upper trolley co-acts with the upper track and has a body with at least one roller having a U-shaped cross section. A lower trolley co-acts with the lower track and has a body with at least one roller having a U-shaped cross section. A frame is attached to the upper carriage and the lower carriage. The frame and the carriages are adapted to move along the

upper track and the lower track. A door is attached to the frame and adapted to move axially relative to the frame. The door, when aligned with the door opening, is adapted to move axially in a first position to seal the door opening and prevent movement of the frame relative to the tracks. When the door is axially moved to a second position, the door is adapted to move away from the door opening so that the frame and door may move laterally along the tracks to expose the door opening. A crank co-acts with the frame and the door to move the door in the first position and the second position.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Figure 1 is a perspective view sketch of a railway boxcar for the purposes of introducing the subject invention;

[0011] Figure 2 is a front elevational view of a railway boxcar similar to that shown in Figure 1;

[0012] Figure 3 is a side elevational view, partially in section, of the railway boxcar along arrows "3-3" illustrated in Figure 2;

[0013] Figure 4 shows a front elevational view of a railway boxcar made in accordance with a second embodiment of the subject invention;

[0014] Figure 5 is a side elevational view of the railway boxcar illustrated in Figure 4;

[0015] Figure 6 is a top view of the trolley and offset arm with the plug door in the open position;

[0016] Figure 7 is a top view of the trolley and the offset arm with the plug door in a closed position;

[0017] Figure 8 is a perspective view of the trolley body in Figures 4 and 5;

[0018] Figure 9 is a partial sectional view of a portion of the trolley further illustrating a safety and weather shield;

[0019] Figure 10 is a perspective view of the offset arm in accordance with the subject invention;

[0020] Figure 11 is a perspective view of the bottom guide in accordance with the subject invention;

[0021] Figure 12 illustrates a side view of a support member having a bent bottom arm;

[0022] Figure 13 is a top view of the same side arm illustrated in its position relative to the door;

[0023] Figure 14 is a side view of a support member having a straight bottom;

[0024] Figure 15 is a top sectional view of the support member in Figure 14 illustrating its relative position to the door;

[0025] Figure 16 is a side elevational view of a portion of a third embodiment of the subject invention;

[0026] Figure 17 is a side elevational view of a portion of a fourth embodiment of the subject invention;

[0027] Figure 18 is a side elevational view of a portion of a fifth embodiment of the subject invention;

[0028] Figure 19 is a front elevational view of a sliding door (non plug-type door) utilizing the trolley system in accordance with the subject invention;

[0029] Figure 20 is an end view of one trolley illustrated in Figure 14;

[0030] Figure 21 is an end view of one lower guide illustrated in Figure 14;

[0031] Figure 22 is a perspective view of a safety arm that may be used with the trolley system; and

[0032] Figure 23 is an end view of the safety arm illustrated in Figure 19 positioned within the confines of the upper trolley body.

DETAILED DESCRIPTION OF THE INVENTION

[0033] Figure 1 illustrates a perspective view showing a railway boxcar 10 having a base 12 with wheels 14 attached thereto. A boxcar enclosure 16 is attached to the base 12 and includes an opening 18 through a wall 20 of the enclosure 16. Typically, the boxcar 10 is rectangular in shape. The opening 18 in a wall 20 of the boxcar 10 may be covered or uncovered by a door 22. In particular, the trolley system for positioning the door 22 of the railway car 10 to cover or uncover the opening 18 in a wall 20 has an upper track 30 mounted upon the boxcar 10 and a lower track 35 also mounted upon the boxcar 10. The upper track 30 engages an upper trolley to support the door 22. The lower track 35 engages a lower guide (not shown) attached to the door 22. While Figure 1 illustrates a door 22 that appears to have no other motion but for lateral motion provided within the upper track 30 and the lower track 35, it should be appreciated and, as will be shown, the door 22 may also be capable of motion in a direction perpendicular to the plane of the door 22 so that the door 22 may be used to plug and unplug the opening 18.

[0034] Figures 2 and 3 illustrate an embodiment of the subject invention, whereby the door 22 is secured to the wall 20 of a boxcar 10 through an upper track 30 and a lower track 35

mounted upon the boxcar 10. It should be noted that Figure 2 is a generalized view while Figure 3 is an accurate representation of a sectional view of Figure 2. A frame 48 supports the door 22 relative to the upper trolley 40 which rides in the upper track 30 and the lower guide 45 which rides in the lower track 35. A crank mechanism 50 rotates a power screw 52 which urges the door 22 into or away from the opening 18 of the boxcar 10. Additionally, the door 20 may move laterally along the upper track 30 and lower track 35 to position the door 22 away from the opening 18 or in alignment with the opening 18.

[0035] The upper trolley 40 has a body 60 with at least one roller 62 rotatably secured therein. The at least one roller 62 of the upper trolley 40 co-acts with the upper track 30. As illustrated in Figure 3, a similar arrangement may exist for the lower guide 45 which, in this instance, is a lower trolley having a lower trolley body 65, with at least one roller 67 rotatably secured therein. The at least one roller 67 of the lower trolley body 65 co-acts with the lower track 35.

[0036] Directing attention again to Figure 3, the roller 62 of the upper trolley 40 has a concave outer surface 64 and the upper track 30 has a convex outer surface 32 which mates with the roller outer surface 64. As illustrated in Figure 3, the concave outer surface 64 of the roller 62 and the convex outer surface 32 of the upper track 30 may be V-shaped. In a preferred embodiment to be discussed, the surfaces are U-shaped.

[0037] The upper track 30 is mounted upon the railway boxcar 10 at the wall 20 and the upper track 30 may further include a bracket 34 which connects the upper track 30 to the wall 20. The bracket 34 may have a Z-shape such that the bracket 34 not only provides support to the upper track 30, but, furthermore, acts to partially enclose the roller 62 of the upper trolley body 60.

[0038] Additionally, a safety plate 70 is connected to the railway car 10 at the wall 20 and positioned above and adjacent to the at least one roller 62. The plate 70 physically limits the vertical movement of the roller 62 in the upper trolley 40 to prevent derailment of the upper trolley roller 62 from the upper track 30.

[0039] The safety plate 70 includes a projection 72 extending from the top of the plate 70 to a location at least partially entering the groove 74 defined by the concave outer surface 64 of the roller 62 to limit the vertical displacement of the roller 62. Utilizing such a design, the upper trolley roller 62 not only is positively retained against the upper track 30, but, furthermore, is retained within a partial enclosure protecting the elements from the environment and, thereby, extending the life of the trolley system.

[0040] In the embodiment illustrated in Figures 2 and 3, the lower guide 45 is comprised of a lower trolley having similar characteristics to the upper trolley 40 just described and, for that reason, it should be understood that the description applicable to the upper trolley 40 in Figure 3 also applies to the lower trolley or lower guide 45 illustrated in Figure 3. The lower guide 45 directs the travel of the door 22 along a path identical to that in which the upper trolley 40 directs the door 22. A support member 80 connects the upper trolley 40 with the lower guide 45. Furthermore, the door 22 is connected to the support member 80. Between the support member 80 and the door 22 is at least one axial guide 82 which permits axial movement of the door 22 in a direction perpendicular to the plane of the door to plug or unplug the door opening 18. The guide 82 permits axial sliding of the door 22 relative to the support member 80 as the door 22 is urged back and forth by the power screw 52 of the crank mechanism 50.

[0041] Referring to Figure 2, the frame 48 may be made up of a plurality of support members 80 and, additionally, a plurality of horizontal reinforcing members 84 connected to the support members 80. The crank mechanism 50 in conjunction with the power screw 52 (Figure 3) moves the door 22 along the axial guide 82 to plug or unplug the opening 18. The door 22 may include a seal (not shown) about its perimeter, such that the door is sealed when moved into the plugged position.

[0042] Independent of the axial motion of the door 22 along the axial guide 82, the door 22 in the unplugged position may also be moved by the upper trolley 40 in a lateral direction along the wall 20 of the boxcar 10 to expose the opening 18 or to position the door 22 in alignment with the opening 18 such that the door 22 may be axially advanced to plug the opening 18.

[0043] The subject invention utilizes many common features of boxcar doors. In many instances, the trolley system herein described may be retrofitted onto existing boxcars with the addition of the upper track 30 and the lower track 35 secured to the wall 20 of the boxcar 10. For that reason, the subject invention can easily be provided in a kit form or, alternatively, a complete new door system could be provided incorporating the above-described invention.

[0044] The subject invention need not be used with only a plug door, but may also be used with a simple sliding railway car door. Furthermore, the subject invention can be used with a single door in a double door arrangement. In the simple sliding railway boxcar door, there would be no crank mechanism and the door would merely slide from side to side along the upper trolley.

[0045] The plug door 22 described in Figures 2 and 3 is a door 22 which, through pure axial motion, is positioned in a plugged or unplugged state. There are other designs for positioning the plug door in the plugged or unplugged position, and attention will be given now to the application of the trolley system in accordance with the subject invention as it may apply to these designs.

[0046] Another mechanism utilized for positioning the door 22 in a plugged or unplugged position involves the use of support members 80 attached to the door 22, wherein the support members 80 are connected to the boxcar with pivoting arms which swing the door 22 along an arcuate path from an unplugged position to a plugged position. During this process the support members 80 pivot. This pivoting motion translates into a rotational motion for the support members 80 and this rotational motion may be advantageously used as a driver to move the door 22 back and forth between the plugged and unplugged position.

[0047] Directing attention to Figures 4 and 5, a second embodiment of the subject invention is illustrated. It should be noted that Figure 4 is a generalized view while Figure 5 is an accurate representation of a sectional view of Figure 4. An upper track 130 is mounted upon the wall 120 of a boxcar 110. An upper trolley 140 has a body 160 with at least one roller 162 rotatably secured therein. The at least one roller 162 of the upper trolley 140 co-acts with the upper track 130. A safety plate 170 connected to the boxcar 110 is positioned above and adjacent to the at least one roller 162 of the upper trolley 140 such that the safety plate 170 physically limits the vertical movement of the roller 162 in the upper trolley 140 to prevent derailment of the upper trolley roller 162 from the upper track 130. However, unlike the safety plate illustrated with respect to Figures 2 and 3, the safety plate 170 defines, in conjunction with the roller 162, a vertical distance D which is less than the vertical distance that would permit the roller 162 and the upper track 130 to become disengaged.

[0048] Directing further attention to the embodiment illustrated in Figures 4 and 5, the door 122 is similar to the door 22 previously described, and includes a frame 148 with support members 180 and horizontal reinforcing members 184. Connector rods 186, which are laterally extended and retracted by the crank mechanism 150, rotate the support members 180 such that the direction of rotation of the support members 180 causes the door 122 to move toward or away from the opening 118 of the railcar wall 120. A turnbuckle 183 may be used with a support member 180 to adjust the overall length of the support member 180 and the distance between the upper trolley 140 and a lower guide 145.

[0049] The top views of the trolley system provided in Figures 6 and 7 illustrate this pivoting motion which positions the door 122 in the plugged or the unplugged position.

Figure 6 illustrates the trolley system, wherein the door 122 is in an open position relative to the opening 118 (Figure 5), in a fashion similar to that illustrated in Figure 5. The support member 180 is connected to the upper trolley 140 and to the lower guide 145. When viewed from the top as in Figure 6, the body 160 of the upper trolley 140 may have two rollers 167 attached thereto, which co-act with the upper track 130. The support member 180 includes a pivot guide 190 for imparting to the support member 180, and to the door 122 connected thereto, an arcuate motion to plug and unplug the door opening 118. For example, Figure 6 illustrates the door 122 spaced from the opening which, for purposes of a discussion, may be located directly beneath the rollers 162, 167. The pivot guide 190 is pivotally attached to the upper trolley body 160 and is rigidly attached to the support member 180. Therefore, with respect to Figure 6, as the pivot guide 190 rotates in a clockwise direction, pivoting about point P on the upper trolley body 160, the pivot guide 190 through the support member 180 moves the door 122 along the arc A to the plugged position as illustrated in Figure 7.

[0050] The upper track 130, upon which the roller 167 travels, extends along the boxcar 110 a length suitable to accommodate the desired lateral motion of the door 122.

[0051] Figures 6 and 7 illustrate the door 122 in the unplugged and plugged positions. It should be appreciated that as the pivot guide 190 follows the arc A, the support member 180 rotates about its longitudinal axis L. Therefore, by rotating the support member 180 about its longitudinal axis L, the pivot guide 190 will pivot, thereby causing the support member 180 and the door 122 attached thereto to follow the arc A of the pivot guide 190. Stated differently, and with attention directed to Figure 4, the connector rods 186 are fastened in an offset manner to collars 188 about the support member 180, such that translation of the connector rods 186 causes each collar 188, along with each support member 180, to rotate about the longitudinal axis L, thereby moving the door 122 between the plugged and the unplugged positions. The crank mechanism 150 imparts such lateral displacement to the connector rod 186, thereby providing the prerequisite motion to position the door 122 in the plugged or unplugged position.

[0052] Figure 8 is a perspective view of the upper trolley body 160 with rollers 167 attached thereto. Integral with the upper body 160 is a limit arm 166 which, as illustrated in Figure 5, is intended to limit the travel of the door 122 away from the opening 118.

[0053] Figure 9 illustrates the arrangement by which the pivot guide 190 of the support member 180 is secured to the upper trolley body 160. In particular, the bore 195 extending through the pivot guide 190 has a kingpin 200 extending therethrough. The kingpin 200 is a cylindrical member having a shoulder 202 at one end thereof and threads 204 at an opposite

end. The kingpin 200 passes through the kingpin hole 168 of the upper trolley body 160 so that the shoulder 202 abuts against a lower surface of the upper trolley body 160. The kingpin 200 is secured to the upper trolley body 160 with a washer 206 and a nut 208 which engages the threads 204 of the kingpin 200. A cotter pin may extend through the nut 208 to retain the nut 208 in the tightened position. The kingpin hole 168 may be lined with a bushing 210 to promote longevity of the joint. The bushing 210 may be of a hardened material or of a composite material having a surface with a level of lubricity to permit sliding.

[0054] Figure 5 and Figure 10 illustrate details of the pivot guide 190 and include the kingpin receiving bore 195 defined in an upper portion 197 of the pivot guide 190. The upper portion 197 is axially spaced from and secured to a lower portion 198 of the pivot guide 190. The upper portion 197 is pivotally secured to the upper trolley body 160 and extends through an opening 211 defined by the safety plate 170, which plate 170 may also function as a safety and weather shield. The lower portion 198 is rigidly secured to the support member 180 through a lower portion hole 199 defined in the pivot guide 190.

[0055] Briefly returning to the embodiment illustrated in Figures 2 and 3, the lower guide 45 in this particular embodiment is a lower trolley essentially duplicating the upper trolley 40 whereby the roller 62 of the upper trolley 40 and the roller 67 of the lower trolley body 65 not only share the weight load of the door 22 and associated frame 48, but, furthermore, each of the rollers 62, 67 is restrained by their respective support plate (70, for example) to limit the upward movement of the rollers 62, 67, thereby preventing derailment of the rollers 62, 67 from the respective upper track 30 and lower track 35.

[0056] Briefly directing attention to the embodiment illustrated in Figures 4 and 5, to the extent that the upper trolley 140 is capable of supporting the entire weight of the door 122 and the associated frame 148, then it is not necessary for the lower guide 145 to support weight. It is necessary, on the other hand, for the lower guide 145 to restrain the door 122 in the frame 148 such that it moves in a path similar to the path dictated by the pivot guide 190.

[0057] Directing attention to Figures 5 and 11, the lower guide 145 includes a guide arrangement 215. As illustrated in these figures, the guide arrangement 215 utilizes an element 216 that may be a roller or a sliding block. A roller would be able to rotate within the cage 232 while a block would slide back and forth within the cage 232. Any block used may have a surface with a level of lubricity that would permit such sliding. A spacer 220 is secured to a body 222 of the guide arm 225. A hole 227 is defined by the body 222 for receipt of a lower portion of the support member 180 as shown in Figure 5. The body 222 passes through a cage opening 230 defined by a cage 232. A gap 234 is defined between an

upper portion of the guide arrangement 215 and a lower surface of an upper portion of the cage 232. In a fashion similar to that of the safety plate 170 for the upper trolley 140, the cage 232 additionally may be used to provide a safety and weather shield 236. As a result, the lower guide 145 has a non-weight bearing guide arm 225 which acts as a guide through the interaction of the guide arrangement 215 and the support member 180.

[0058] Figure 5 illustrates an arrangement whereby the support member 180 is connected to the door 122 with connector segments 182 which are rigidly connected to the door 122, but permit rotation of the support member 180 therein. At the same time, the support member 180 provides vertical support to the door 122.

[0059] To reduce the overall width of a boxcar which implements the trolley system in accordance with the subject invention, it is possible to move the support member 180 closer to the door 122. As illustrated in Figures 12 and 13, the bottom portion of the support member 180 may have a bent bottom segment 238 which, in conjunction with a similar geometry for the pivot guide 190 (Figure 5), permits the support member 180 to be placed much closer to the door 122 to the point where, as illustrated in Figure 13, the support member 180 may fit within a recess 124 within the door 122. In the alternative, as illustrated in Figures 14 and 15, the support member 180 may be entirely straight, and, as a result, the support member 180 would be spaced a further distance from the door 122 through extended connector segments 282.

[0060] Figures 16 and 17 illustrate different mechanisms whereby the wheel of the trolley may be positively retained against the upper track.

[0061] In particular, and directing attention to Figure 16, an upper trolley 340 has similar features to upper trolley 140 and upper trolley 40 previously discussed. However, the safety plate 370 which retains the roller 360 against the upper track 330 is made up of a projection 372 having a matching V-shape to that V-shape of the roller 360. As a result, the safety plate 370 retains the roller 360 against the upper track 330 such that it may not derail.

[0062] In the alternative, and as illustrated in Figure 17, in which all of the features are identical to those in Figure 16, with the exception of the safety plate 470, the safety plate 470 is essentially a flat piece placed close to the top of the roller 360, thereby, once again, limiting the vertical movement of the roller 360, such that it may not derail from the upper track 330.

[0063] Figure 18 illustrates an upper trolley 440 having all of the features of those upper trolleys previously discussed, with the exception that the previous trolleys have wheels having a V-shaped groove compatible with a mating V-shaped track. The upper trolley 440

illustrated in Figure 18 includes a roller 460 having an upper track 430 with a semi-circular shape to engage the roller 460. However, once again, the safety plate 470 is positioned such that the roller 460 may not be vertically displaced to a level that would permit it to be derailed from the upper track 430. The safety plate 470 and platform 434 supporting the upper track 430 define a cage 432.

[0064] The trolley system so far discussed has been directed to an arrangement in conjunction with a plug door. However, as illustrated by Figure 19, the trolley arrangement may also be applied to a simple sliding door 522 which does not have a plug door associated with it, but merely must move laterally along an upper track 530. To that end, an upper trolley 540 having features similar to any of the upper trolleys (40, for example) previously discussed herein may be utilized to provide a trolley that is positively retained against the upper track, thereby minimizing the likelihood of derailment. Additionally, a lower guide 545, similar to the lower guides herein discussed, may be utilized. Figure 20 illustrates an end view of the upper trolley 540 that may be utilized including an upper track 530, an upper trolley 540 having at least one roller 560 secured therein, and a safety plate 570 which retains the roller 560 and prevents derailment from the upper track 530. Additionally, a lower guide 545 incorporating a guide arrangement 515 captured within a cage 532 provides a mechanism by which the door 522 tracks in a similar path through the upper trolley 540 and the lower guide 545.

[0065] With reference to Figure 4, the door 122 may include at least one safety arm 600. Details of the safety arm are illustrated in Figures 22 and 23.

[0066] The safety arm 600 is comprised of a frame 605 having an overhung portion 610 that is positioned vertically above the upper track 430 but laterally spaced from an upper trolley 140 (Fig. 4). The frame 605 is secured to the door 122 at the frame base 607. As long as the door 122 is properly supported by the upper trolleys 160, then the safety arm 600 is suspended within the cage 432 of the upper trolley 440, i.e., the roller 460 (Fig. 18) is engaging the track 430. However, in the event one or more upper trolleys 160 become derailed from the track 430, the door 122 will fall vertically only until the overhung portion 610 of the frame 600 engages the track 430 or the platform 434 supporting the track 430. A projection 615 may extend from the frame 605 and would engage a lip 472 of the safety plate 470 to further retain the frame 605 within the cage 432.

[0067] The trolley system described herein may be provided as a kit and currently existing boxcars may be retrofitted. In particular and with reference to Figure 5, the guide tracks of an existing boxcar may be removed and the upper track 130, safety plate 170, and the cage

232 may be secured to the boxcar 122. Additionally the support member 180 may be secured through connector segment 182 to the door 122. The support member 180 is also secured to the upper trolley 140, which is upon the upper track 130 and to the guide arrangement 215, which is within the cage 232.

[0068] While specific embodiments of the invention have been described in detail, it will be appreciated by those skilled in the art that various modifications and alternatives to those details could be developed in light of the overall teachings of the disclosure. The presently preferred embodiments described herein are meant to be illustrative only and not limiting as to the scope of the invention which is to be given the full breadth of the appended claims and any and all equivalents thereof.